Description

# Low voltage circuit breaker

The invention relates to a low voltage circuit breaker which comprises a contact system for a principal current and an arc extinction chamber. An arc transmitting element is disposed between the contact system for the principal current and the arc extinction chamber.

It is known that the size, particularly the width of contact systems for the principal current of low voltage circuit breakers depends on a nominal current for which the low voltage circuit breakers have been designed. The higher this nominal current, the wider is the embodiment of the corresponding contact systems for a principal current. A disadvantage here is the fact that on the basis of strongly defined proximity effects for wider contact systems for a principal current, a complicated arc extinction behavior is exhibited because the arc predominantly occurs at the edge of the wide contact systems for a principal current and accordingly predominantly dwells in the edge zone of the arc extinction chamber allocated to the contact systems for a principal current. As a result, the cooling effect of the arc extinction chamber is only used in a limited manner. This leads to the fact that the arc is extinguished relatively late and the danger arises that ionized circuits may escape from the arc extinction chamber. This burning off or down of the arcs in the edge zone occurs both during interruptions in the nominal current zone and during short-circuit interruptions of this low voltage circuit breaker.

In order to make possible an explicit transmission of arcs into arc extinction chambers, it is known from DE 35 39 673 A1 that an arc-conductive piece of a ferromagnetic material must be allocated to a contact system for a principal current by

means of which the arcs are to be explicitly transmitted to the arc extinction chamber. The disadvantage of this arrangement is the fact that additional components must be provided which are directly connected to the contact systems for a principal current. This complicates the structure of the low voltage power switch and low manufacturing and/or assembly tolerances already lead to a failure when the arcs are conducted away.

Therefore, it is the object of the invention to create a low voltage circuit breaker according to said type in the case of which arcs defined in an arc extinction chamber can be transmitted in a simple manner.

According to the invention, this object of the invention is achieved by means of a low voltage circuit breaker with the features mentioned in Claim 1. Because said arc transmitting element disposed between the contact system for a principal current and the arc extinction chamber comprises at least one arc conductive element which makes it possible to direct said arc in a defined manner to the arc extinction chamber, it is advantageously achieved that the arc is directed away from the contact systems for a principal current to be protected against burning down, and that a shorter arc extinction period is reached. This results in decreasing the stress on both the contact systems for a principal current, on the one hand, and the arc extinction chamber, on the other hand, because these basically can now, by means of a defined start-up by the arc, convert their arc extinction capacity with a high degree of effectiveness. It has been proven that by providing simple arc conductive elements to the arc transmitting element, it is possible to direct the arcs in a defined manner. Changes to the contact system for the principal current itself need not be made so that the modifications according to the invention are only limited to the arc transmitting element alone. As a

result, the solution according to the invention is very simple and can therefore also be implemented cost-effectively in mass-produced low voltage circuit breakers.

In a preferred embodiment of the invention provision is made so that at least one arc conductive element extends at an angle to an imagined vertical line of the arc transmitting element away from an edge zone in the direction of a middle zone. - This advantageously results in the fact that the arc is directed via at least one arc conductive element approximately into the middle of the arc extinction chamber so that the desired arc extinction effect can be very securely achieved.

In a further preferred embodiment of the invention provision is made so that the arc conductive element has at least one running edge basically running parallel to the arc transmitting element. - As a result of this an optimum arc position can be controlled within the arc extinction chamber in a defined manner. - The running edge can be formed by a sharp-edged transition of a step.

In addition, in a preferred embodiment of the invention provision is made so that the arc conductive element particularly has several running edges running at different angles to the imagined vertical line. - By means of such a ray-shaped system of the running edges on the arc transmitting element, the arc is directed safely into the middle zone of the arc extinction chamber independent of the point of origin of the arc.

In a further preferred embodiment of the invention provision is made so that the arc conductive element is non-positively connected to the arc transmitting element. As a result of this, the arc conductive element can be embodied in a simple fashion. This only requires the manufacturing of an arc conductive element with a simple design - for example, as a crown-shaped stamped part - and the fixing of this arc conduc-

tive element to the arc transmitting element - for example, by means of welding. In the case of a correspondingly selected system of pronged rays of the crown-shaped stamped part, the running edges can be determined for the arc in a simple way. In this way, particularly the different sizes of the arc extinction chambers can be adapted easily. The rays preferably have two running edges for the arcs running at right angles to one another which run from the edge zone of the arc transmitting element into the middle of the arc extinction chamber. As a result of this, depending on the point of origin and the intensity, it is possible to direct said adapted arc to the arc extinction chamber.

The arc conductive element connected non-positively to the arc transmitting element in addition offers the advantage that a bigger cooling body is available in the zone of the arc transmitting element which favorably influences the extinction behavior of the arc extinction chamber.

At least one section of a wire, particularly a steel wire can also serve as an arc conductive element.

According to a further preferred embodiment of the invention provision can be made for at least one arc conductive element being embodied as a profile part stamped from the plane of the arc transmitting element. This simplifies manufacturing of an arc transmitting element that features arc conductive elements.

At least one end plate of a stack of extinction sheets can be used advantageously as an arc transmitting element.

Further preferred embodiments of the invention can be found in the other features mentioned in the subclaims.

Other advantageous further developments of the invention are

explained below on the basis of the accompanying drawings. They are as follows:

Figure 1 partial sectional view through a low voltage circuit breaker;

Figure 2 view from above of an arc transmitting element;

Figure 3 sectional view through the arc transmitting element;

Figure 4 enlarged detailed view of the arc transmitting element and

Figure 5 schematic perspective view of an arc transmitting element.

Figure 1 shows part of a sectional view of an arc extinction chamber 10 of a low voltage circuit breaker 12. The low voltage circuit breaker 12 is embodied for a relatively high nominal current, for example, 1000 A.

A contact system for a principal current 14 of the low voltage circuit breaker 12 comprises a fixed principal contact 16 with a contact facing 18 as well as a movable principal contact 20 with a contact facing 22. If required, these principal contacts 16 and 20 are provided repeatedly in a parallel system. The higher the nominal current, the wider is - according to the view into the paper plane - the embodiment of the contact system for a principal current.

The principal contacts 16 and 20 are used for the arc-free transmission of the permanent current of the low voltage circuit breaker 12 in the closed state of the principal contacts 16 and 20.

The contact system for a principal current 14 also comprises a fixed blow-out contact 24 with a contact facing 26 and a movable blow-out contact 28 with a contact facing 30. Arc horns

32 or 34 are allocated to the blow-out contacts 24 and 28.

An insulating coupling 36 serves for connection to a driving arrangement and reset device (not shown) in order to open and close the contact system for a principal current 14.

The arc extinction chamber 10 comprises a housing 38 which encloses an inner space 40 serving an arc extinction. In the inner space 40, a stack of extinction sheets 41 consisting of extinction sheets 42, 43 is arranged in a known way. An arc transmitting element 44 limits the inner space 40 of its fixed contact side. In principle, the arc transmitting element 44 is embodied plate-shaped and carries on its side facing the inner space 40, an arc conductive element 46 whose structure will be explained in greater detail below on the basis of the following drawings. The arc gases (switching gases) formed in the course of the extinction process escape from the arc extinction chamber 10 through an outlet 50, provided on the top side, subdivided into passages 48; said gases escaping in the direction of the arrows 52. In addition, a further switching gas damper can be arranged at the top side of the arc extinction chamber 10.

The arc conductive element 46 is arranged in the vicinity of the arc transfer points from the arc horn 32 to the arc transmitting element 44.

Figure 2 shows a view from above of an arc transmitting element 44 which clearly shows the arrangement of the arc conductive element 46 on the arc transmitting element 44. The arc conductive element 46 is arranged non-positively as an additional part on the surface of the arc transmitting element 44 and spot welded to it or joined using a similar method. According to a further embodiment, the arc conductive element 46 can be stamped from the plane of the arc transmitting element 44.

The arc conductive element 46 comprises running edges 54 which form the side limit of ray-shaped prongs 56. In this case, the running edges 54 run at different angles in each case to an imagined vertical line 58 through the arc transmitting element 44. In this case, the running edges 54 are embodied in such a way that they run from a bottom edge zone in the direction of the top middle zone of the arc transmitting element 44.

The sectional view in Figure 3, as well as the enlarged detailed view in Figure 4, show that the running edges 46 are formed by steps 60 running basically vertically to the plane of the arc transmitting element 44 so that there is a sharp-edged transition 62 on the surface of the arc conductive elements 46.

Figure 5 in a perspective view again shows the plastic protrusion of the arc conductive element 46 on the arc transmitting element 44. This results in an embodiment of the running edges 54 as sharp-edged transitions 62 of the steps 60.

The number of arc conductive elements 46 as well as the number of running edges 54 can be adapted to the design of the low voltage circuit breaker 12, particularly to the arc extinction chamber 10.

The ray-shaped running edges 54 running from the edge zones of the arc extinction chamber 10 into the middle zone of the arc extinction chamber 10 lead to the arcs originating in the edge zone at the contact system for a principal current 14 being safely directed into the middle zone of the arc extinction chamber 10 where these are extinguished particularly effectively. Because of the system of an arc conductive element 46 in the transfer zone of the arc horn 32 on the arc transmitting element 44, the arcs can be directed particularly well into the middle zone of the arc extinction chamber 10.

Each one of the two end plates 43 of the stack of extinction sheets 41 can be used as an arc transmitting element and as a result be provided with an arc conductive element.

According to further embodiments which are not shown, instead of the shown arc conductive element 46 which either has a crown-shaped or neck-shaped embodiment, provision can also be made for the running edges 54 being formed from welded-on individual elements, for example, steel wire or the like. However, the system of a relatively large additional part which embodies a plurality of running edges 54, at the same time, leads to an embodiment of an additional mass which has a cooling effect on the arcs at a very early point in time for the switching-off process of the low voltage circuit breaker 12 so that a further improvement of the extinction behavior is achieved.